3.2 Overview of Assessment Modeling Based on Data Availability

SWFSC, FRD

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Stock Assessment Topics

1. How data controls model complexity data
2. Model complexity and management uncertainty
3. Strengths, Challenges and Strategies

What is a stock assessment?

Synthesis of existing knowledge and data
recreating past population dynamics
to learn about current status and future sustainable catch levels.

Define what is a population/stock?

Population/stock

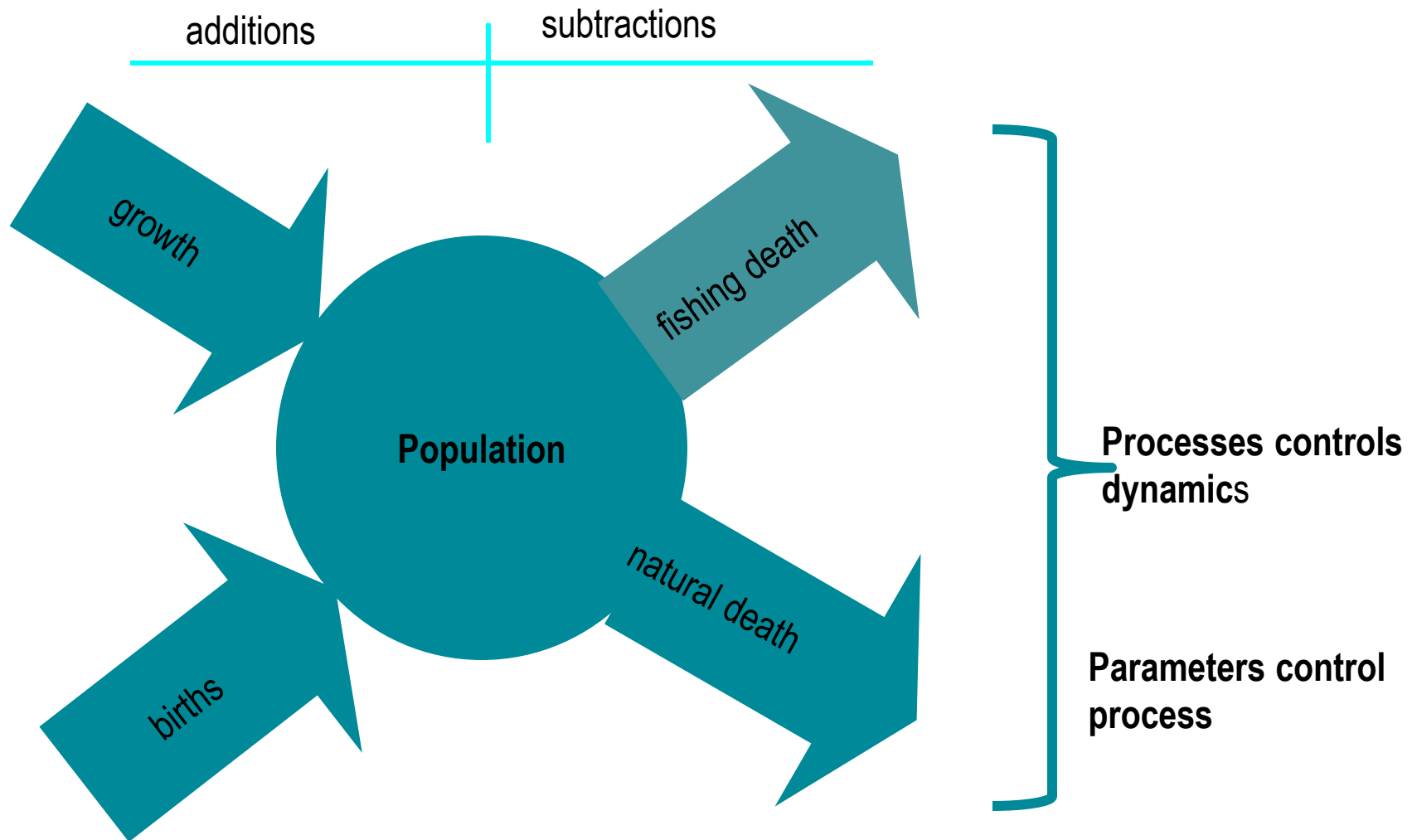## Common biological processes

Spawning grouping with young contributing
Common growth and death patterns
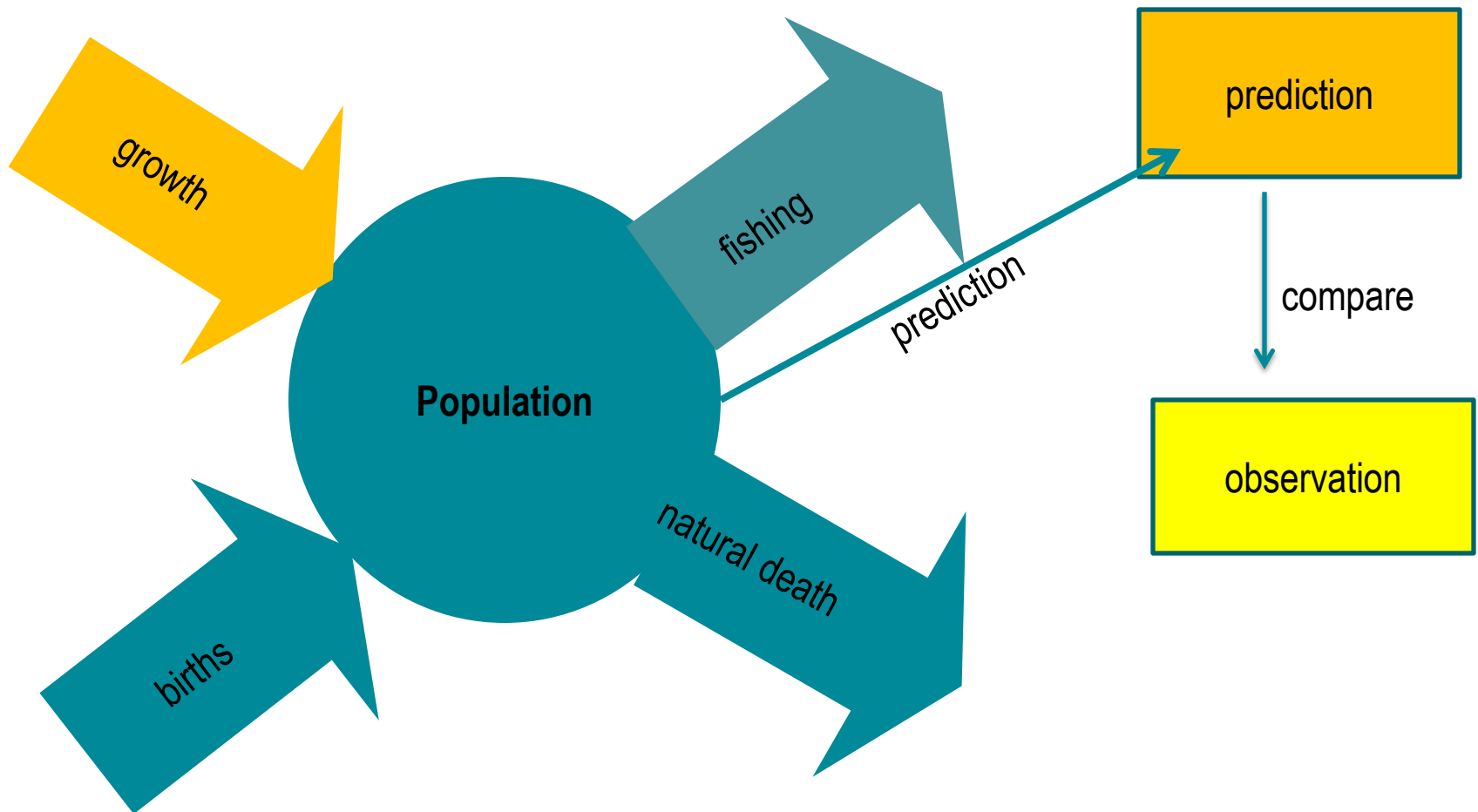Exploited by defined groups

No emigration or immigration

Attributes

Biomass
Numbers
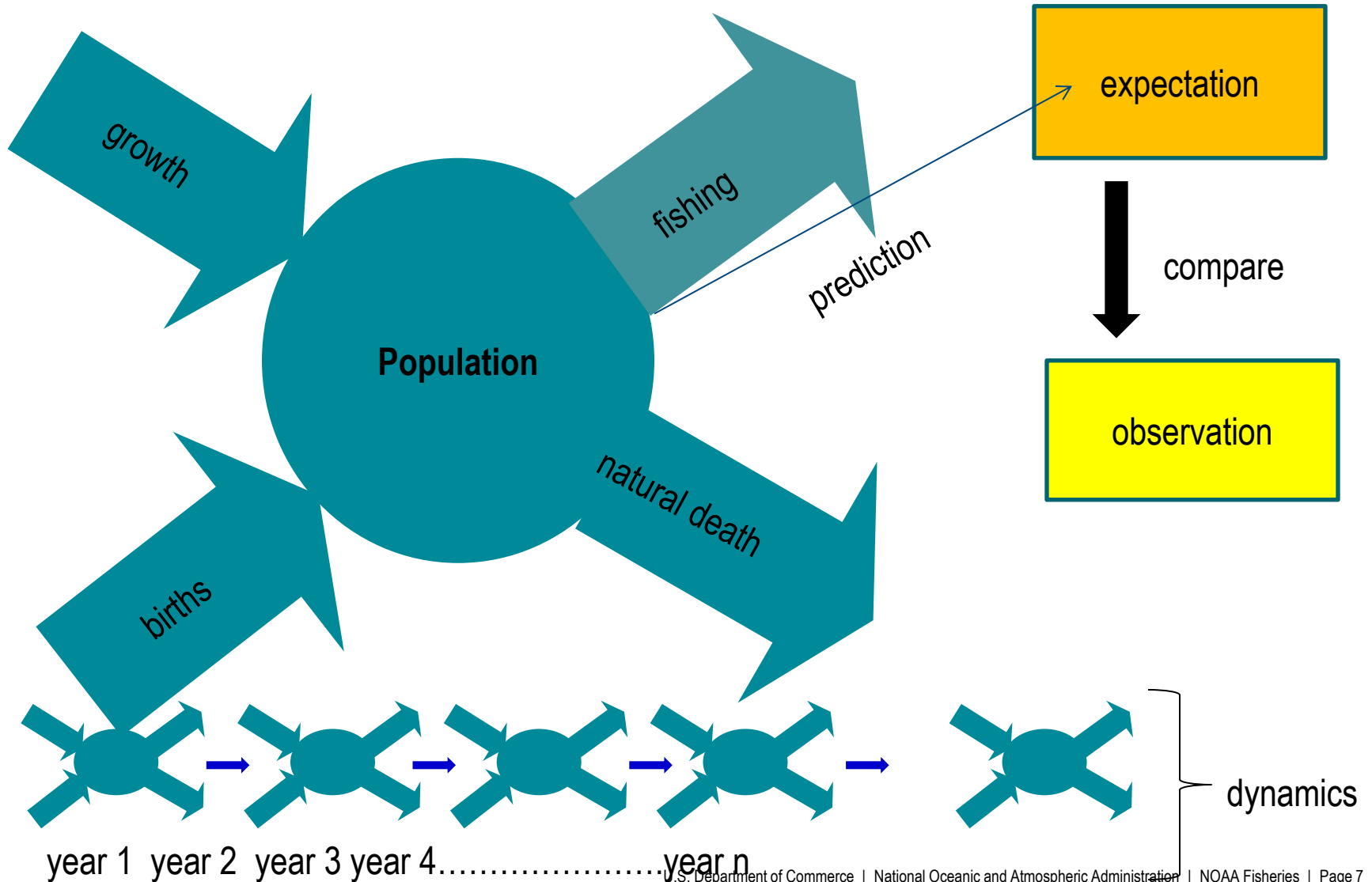B/N at age
B/N at age and sex
B/N at age and sex by area….etc.

Stock Assessments are Population Models

additions | subtractions

growth

births

Population

fishing death

natural death

Processes controls dynamics

Parameters control process

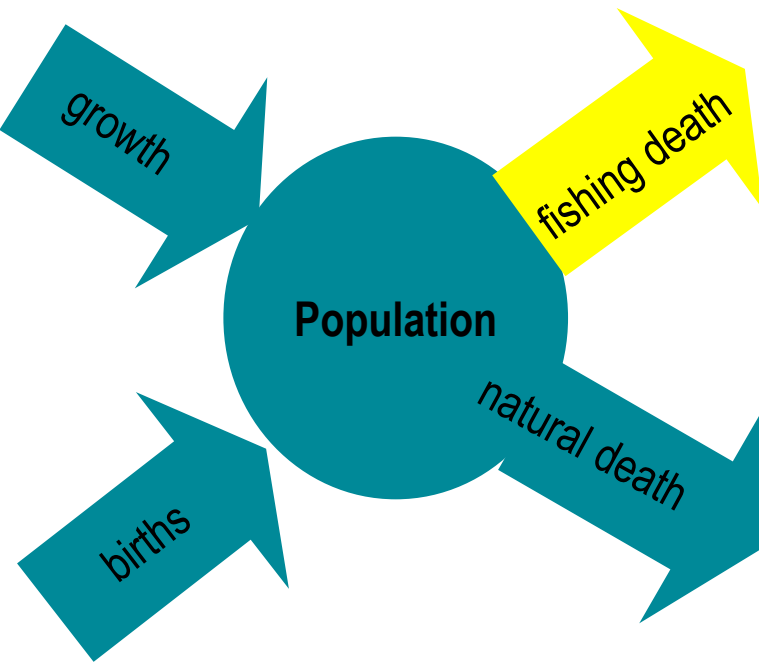# The role of Data

Dynamic Population Models

NOAA FISHERIES

The Basics…….

Catch
and
Index of Abundance

Catch : what have we removed from the population

Blue Shark "catch"

Legend:
- F1_MEX
- F2_CAN
- F3_CHINA
- F4_JPN_KK_SH
- F5_JPN_KK_DP
- F6_JPN_ENY_SHL
- F7_JPN_ENY_DP
- F8_JPN_LG_MESH
- F9_JPN_CST_Oth
- F10_JPN_SM_MESH
- F11_IATTC
- F12_KOREA
- F13_NON_ISC
- F14_USA_GILL
- F15_USA_SPORT
- F16_USA_Lonline
- F17_TAIW_LG
- F18_TAIW_SM

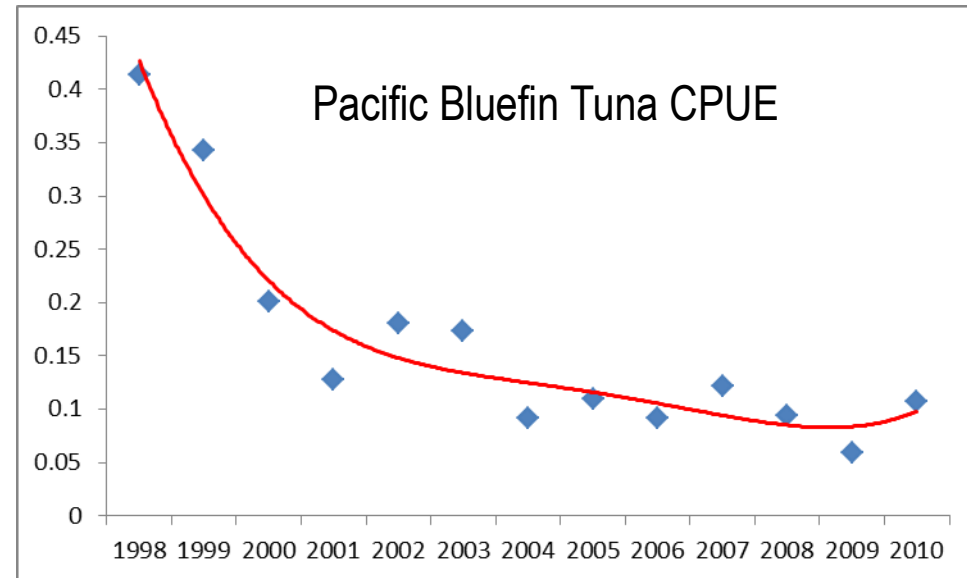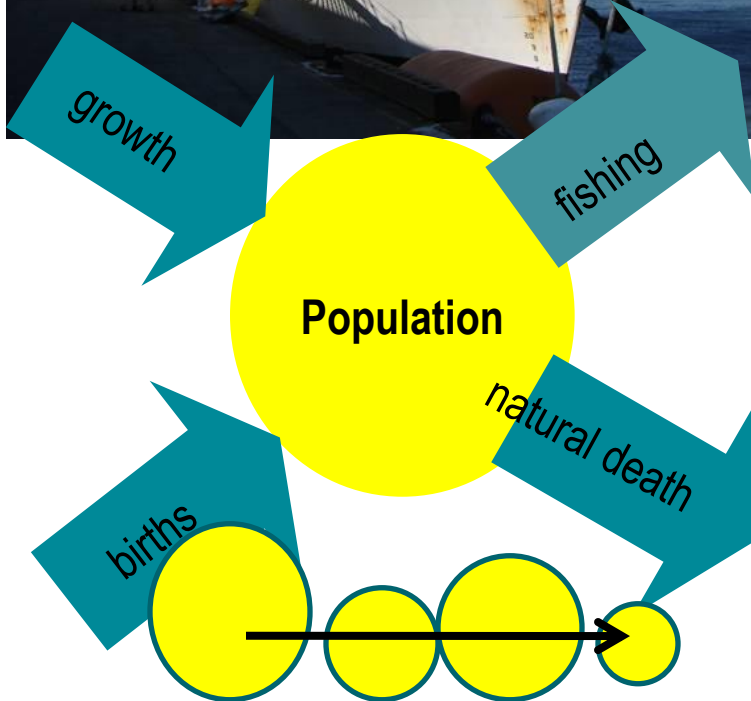Diagram labels: growth, fishing death, Population, natural death, births

Catch=Kills
Includes fish not kept!
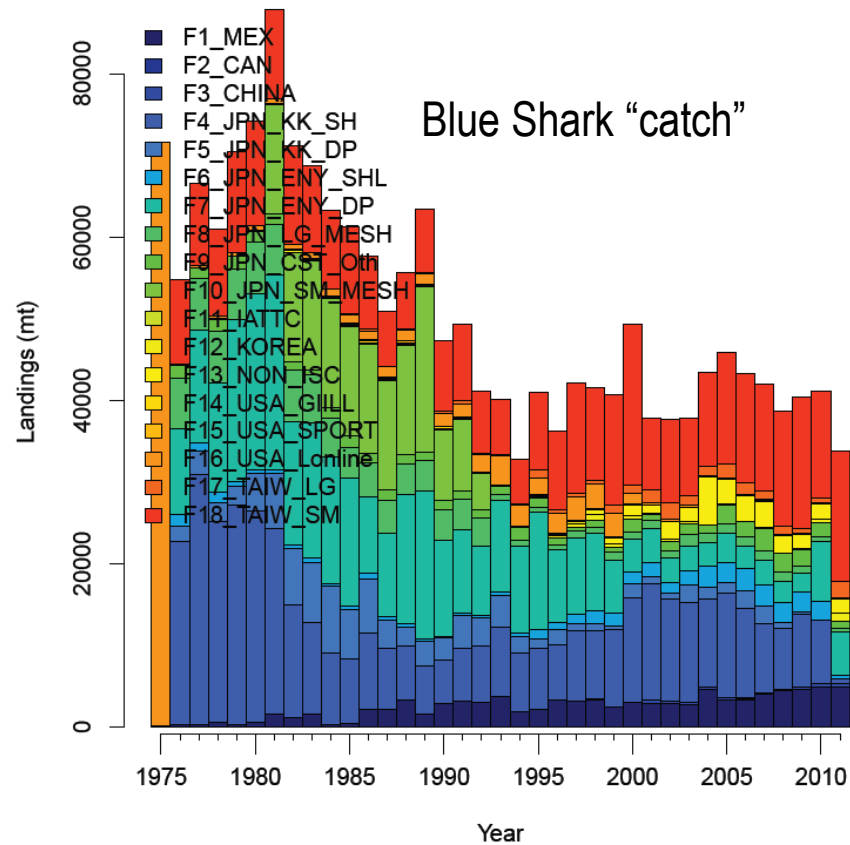
Indices of abundance: Tell us how population abundance changes

Fishery Independent vs Fishery Dependent
Absolute vs Relative

growth

fishing

Population

natural death

births

Pacific Bluefin Tuna CPUE

NOAA FISHERIES

Biomass Dynamic (production models)

- Data (**minimal**): catch and index of abundance

- Complexity/Realism: Incorporates all processes (recruitment, growth, and natural mortality) into a single aggregate function of production

births

natural death

growth

Intrinsic rate of increase

Population

catch
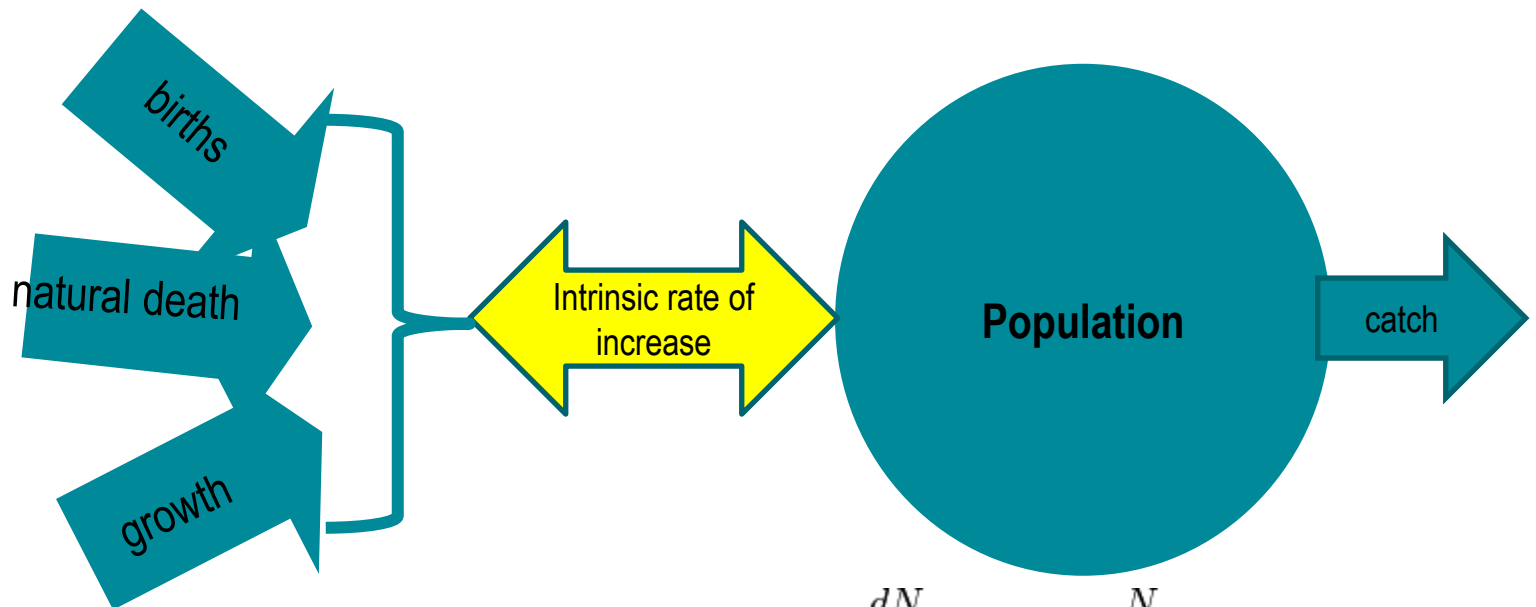
$$\frac{dN}{dt} = rN(1 - \frac{N}{K}) - H$$

- Few but Strong assumptions

Life History:

How fast do they grow
when are they mature
**How quickly do they die naturally**

$$N_{t+1} = N_t \, e^{-Zt}$$
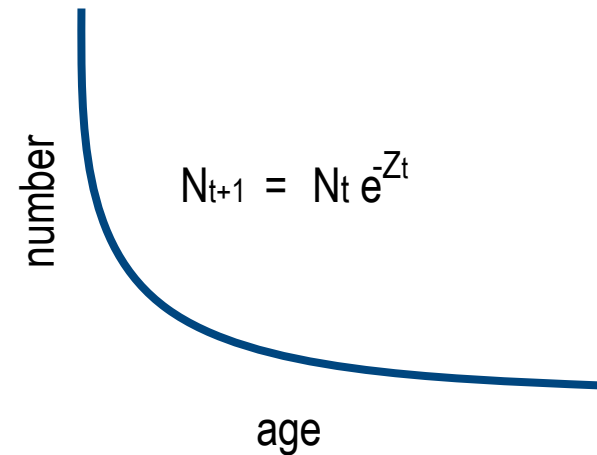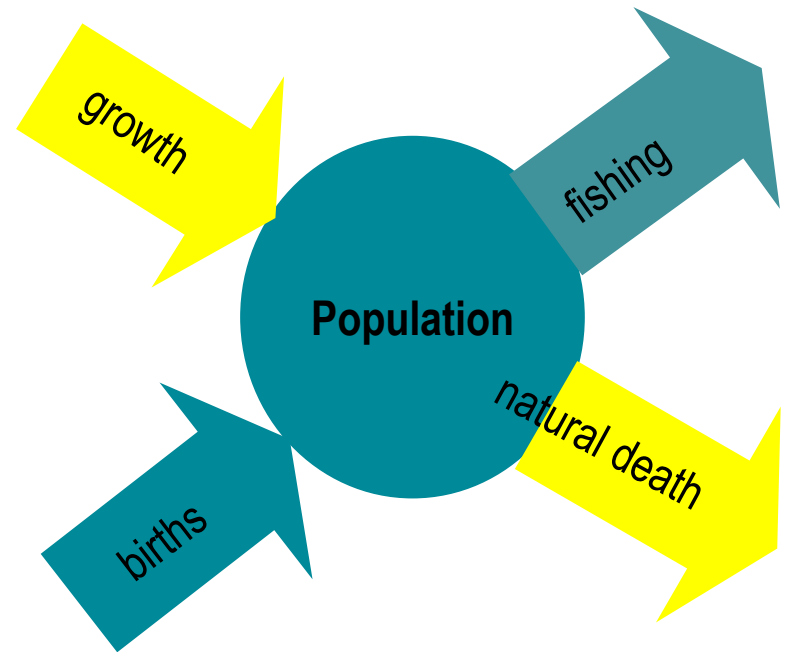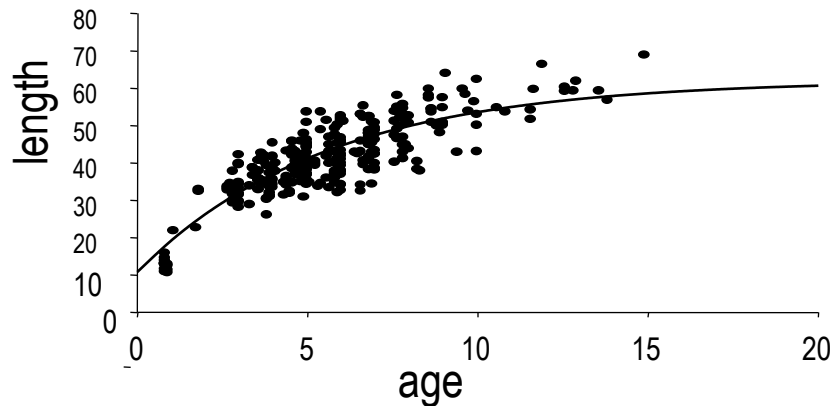
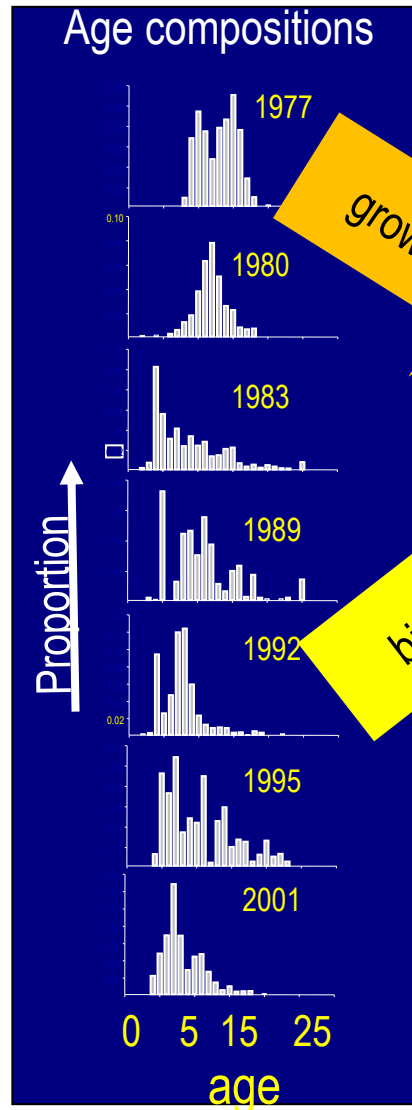# Age-structured production models
(inclusion of S/R relationship)

Data (**moderate**): Uses more biological detail than a surplus production model (keep track of age-specific quantities)

- Data: catch, index and life history (growth and M)
- Complexity: adds all relevant processes, but simplified
- More assumptions but explicit and testable
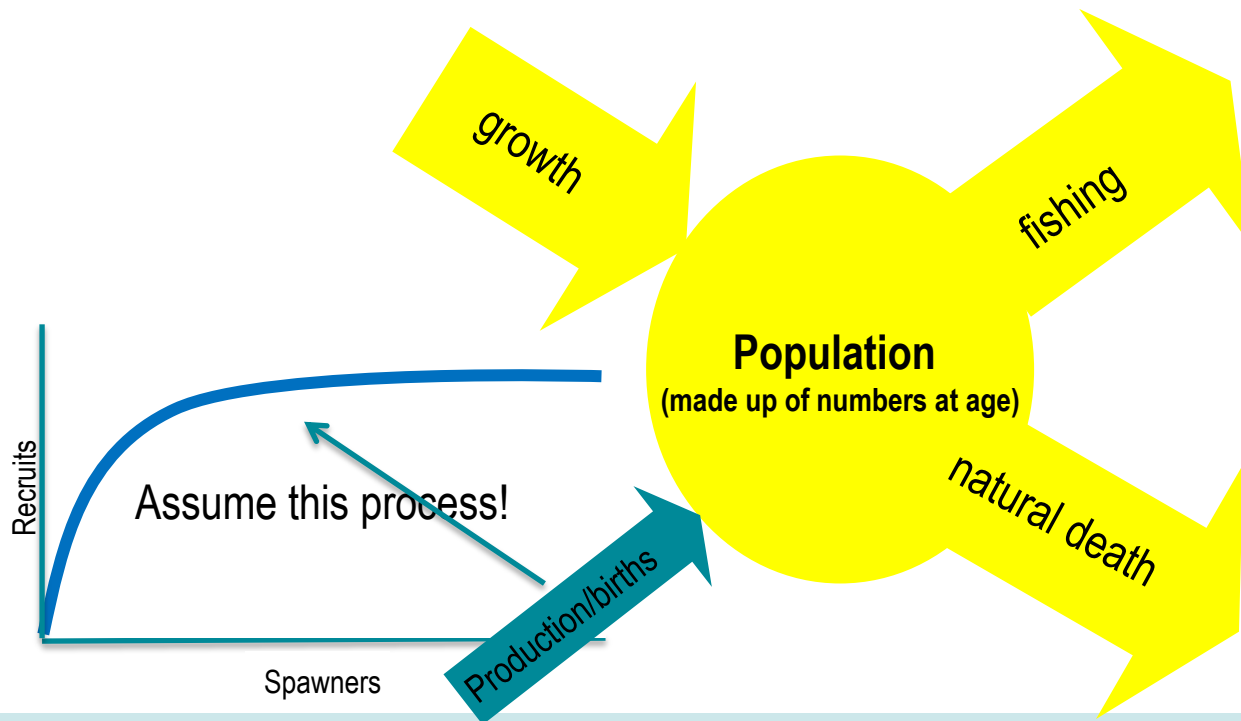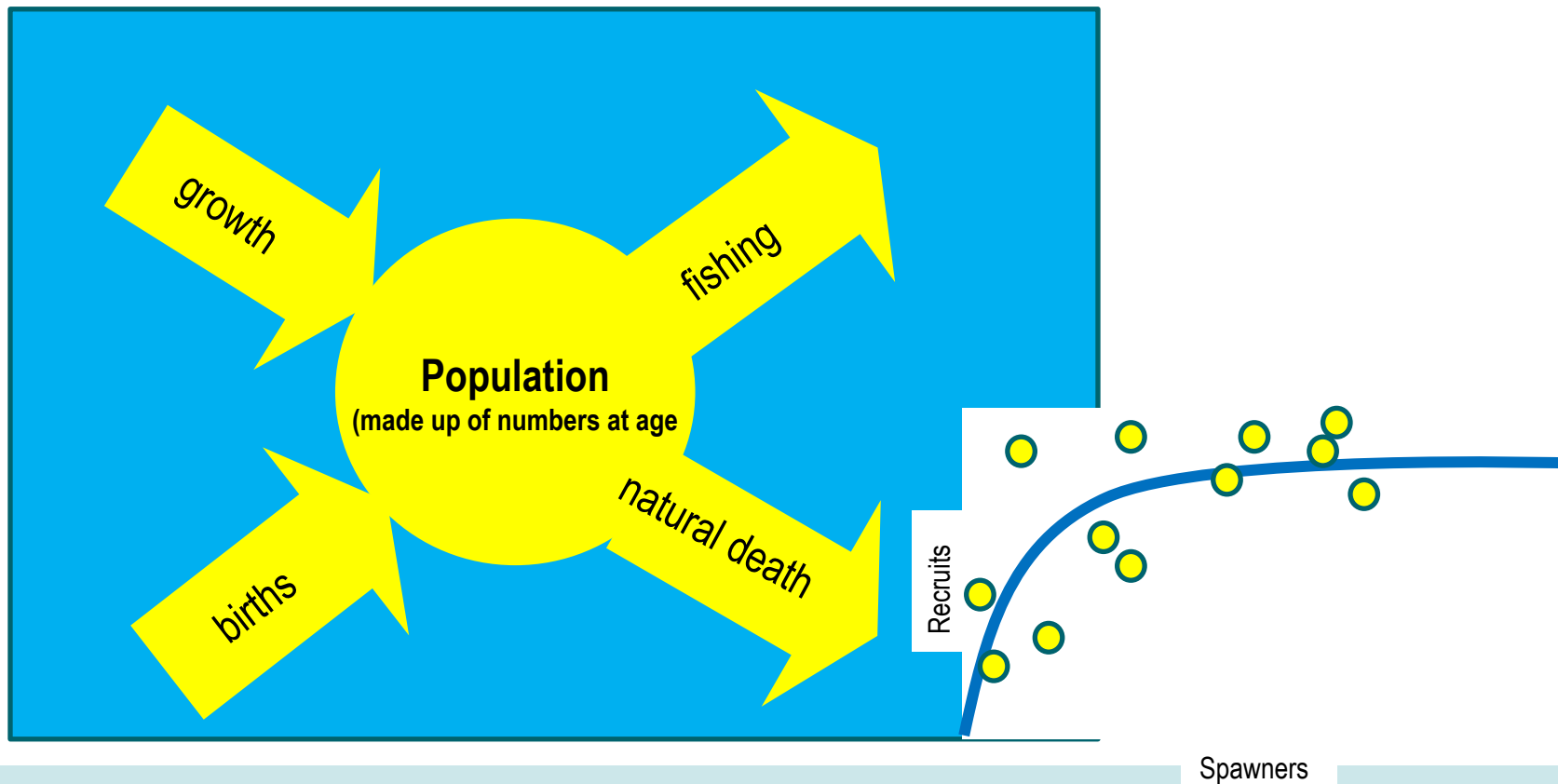
Biological data: demographics of the population

Age Structured Models

- Data (**rich**)- catch, index, life history and composition
- Complexity: With appropriate data, almost all processes can be modeled explicitly
- Assume that the processes match reality
- **Full dynamics can be estimated- e.g. Year-specific births**
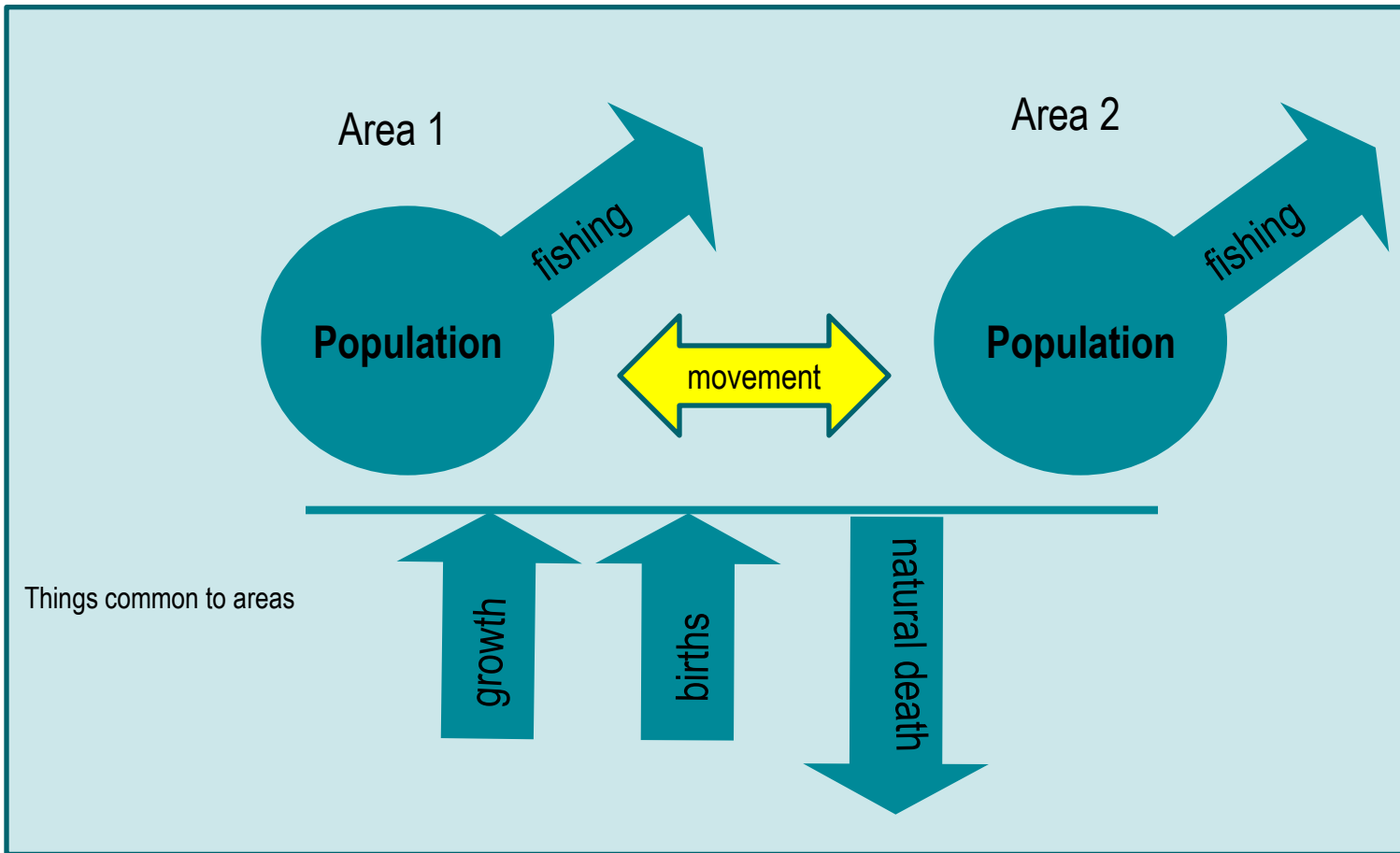
Truly data intensive models!

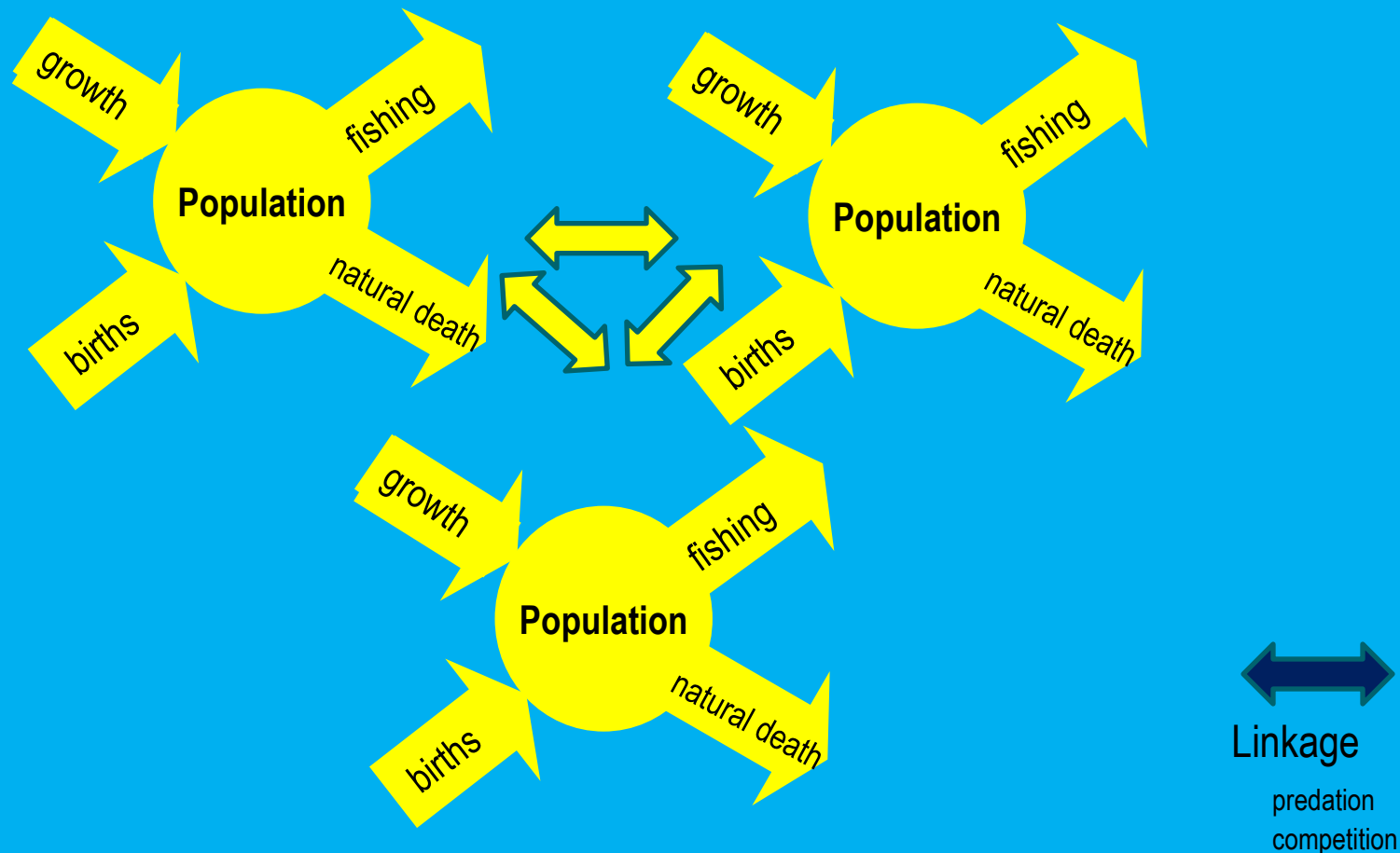Spatial patterns and movement

Multi-species and Ecosystem

Spatially Structured models

- TRULY Data intensive- Need all the information of previous models and MOVEMENT between areas

Multi-species Models

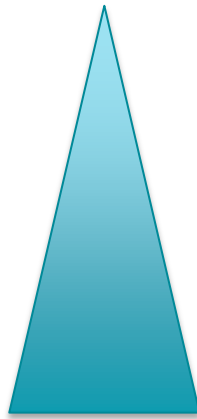- Amazingly Data intensive- Need linkages between species

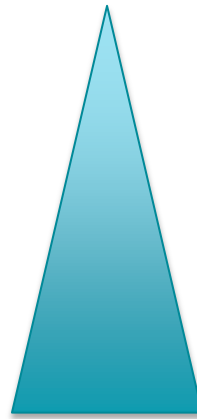# Population models are a tradeoff of complexity and realism
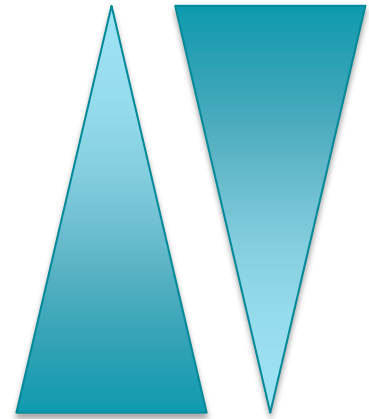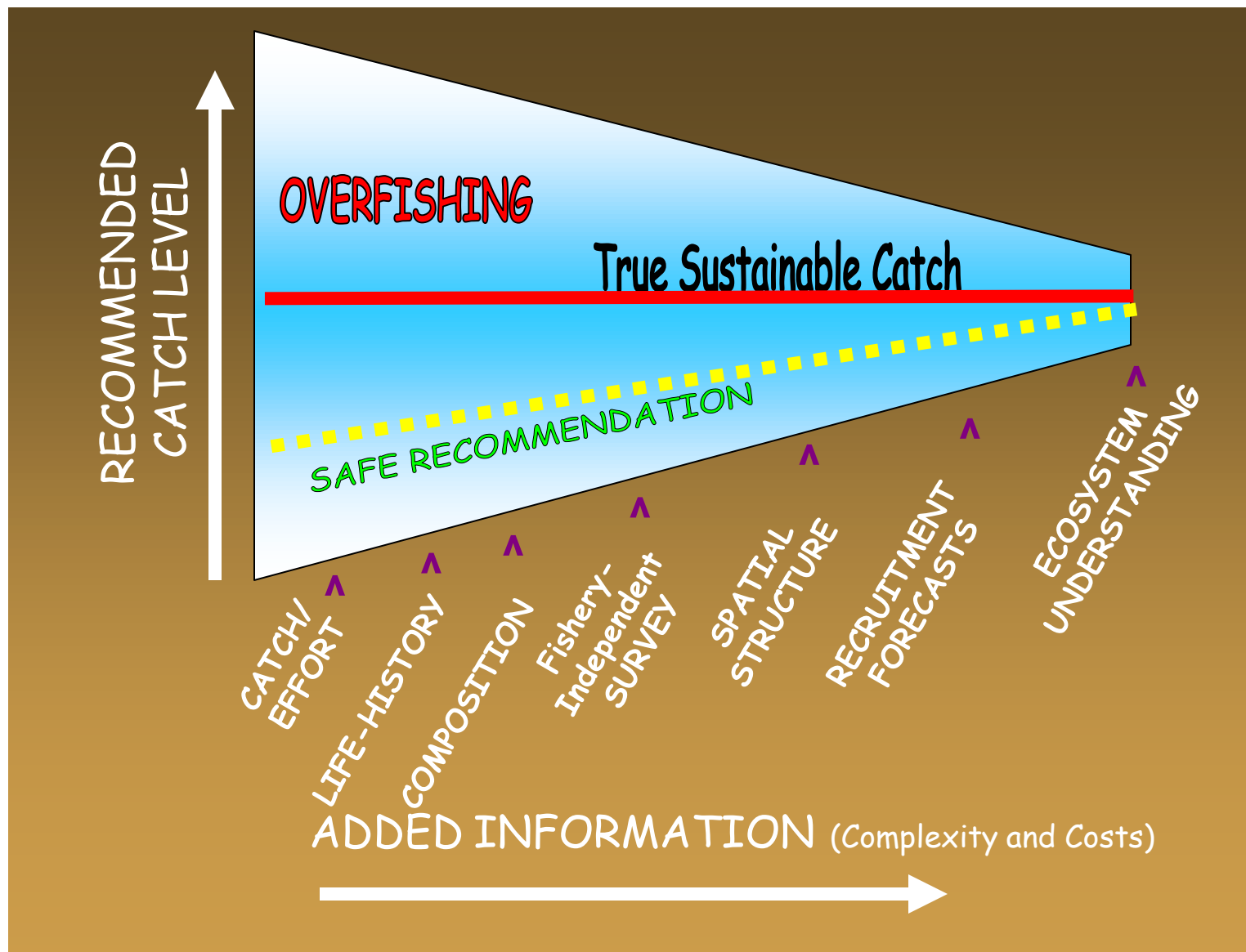
Simple models

Complex models

Data needed

Model realism

Assumptions

Why does assessment complexity/realism matter…………

Strengths

Range of models to match data complexity

Models contain enough process to match most situations

Increasing our understanding of how to use model process
to emphasize important data types and minimize others- e.g. time varying selection

Challenges

Data for important model processes still missing- e.g. movement

Strategies

Improve understanding of biology and improved data collection to better incorporate
relevant model process